Air and Space Traffic Interaction Research (ASTIR)

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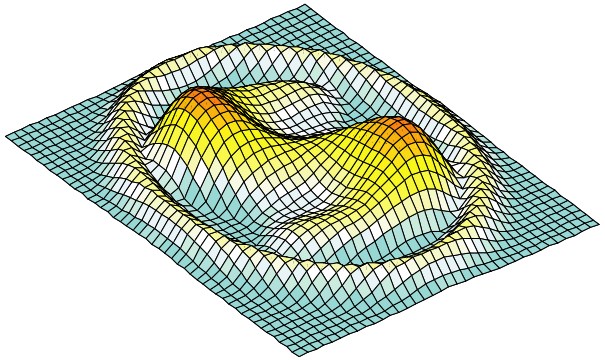
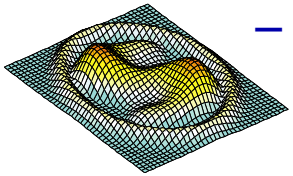
En Route Modeling Workshop
FACET Workshop, March 13, 2003



Anticipated Increase in Space Launches Impacts Air Traffic in National Airspace System

- Increase in space launches anticipated due to
  - consumer demand for information services
  - defense requirements on information warfare
  - research missions for Earth science and space science
- Variety of space vehicles and mission-profile differences
  - NASA Reusable Launch Vehicle (RLV) Program, X Vehicles, Space Launch Initiative (SLI), National Aerospace Initiative (NAI)
  - DoD Evolved Expendable Launch Vehicle (EELV) Program
  - Foreign-government programs: Europe, Russia, Ukraine, China, Japan, India, Brazil
  - Privately funded commercial launch vehicles (e.g. Kelly – Astroliner, Kistler – K-1, Pioneer Rockplane – Pathfinder, Rotary Rocket – Roton, etc.)
- Important to understand impact of space operations on NAS, and to redefine operational concepts accordingly
  - FAA Space and Air Traffic Management Systems (SATMS)



Future ATM Concepts Evaluation Tool (FACET)

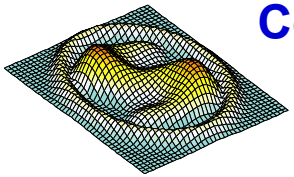
Flexible environment for rapid prototyping of new ATM concepts

Interfaces with Host and ETMS data

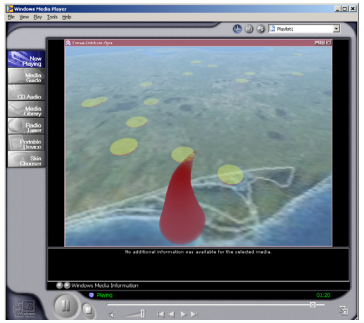
Models airspace operations at US national level (~10,000 aircraft)

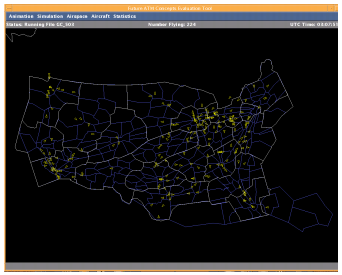
Enhancements

Configurable Airspace Research and Analysis Tool (CARAT)



CARAT Functional Components

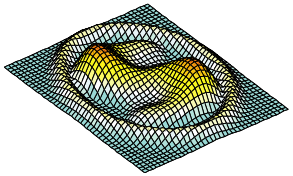




3D Graphics

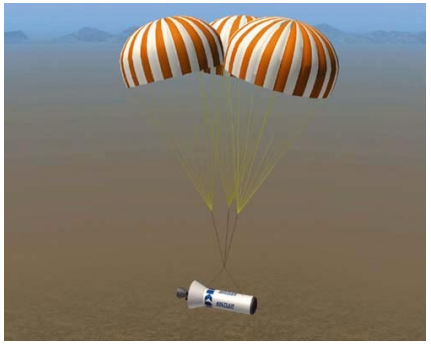
FACET | Space Vehicle Models | Special Airspace Definitions | Flight Safety Analyses

Model Database

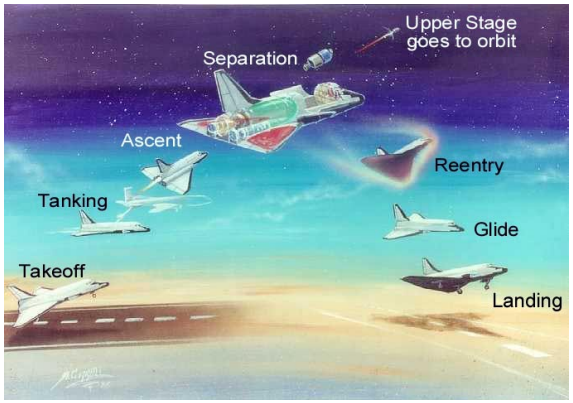


Variety of Flight Vehicle Concepts

VentureStar/X-33



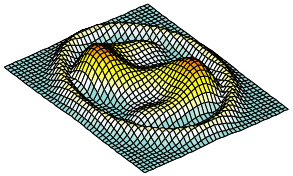
Kistler K-1



Pioneer Rocketplane

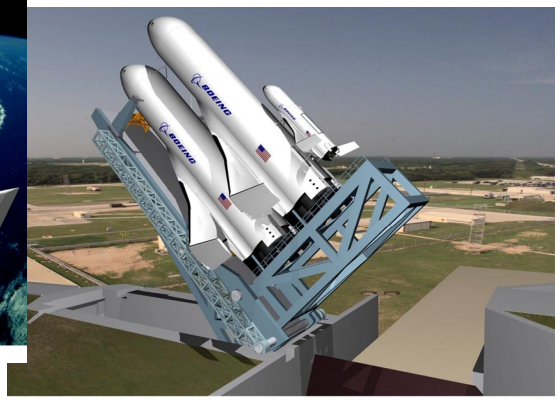
KST K2GenRLV

Space Access SA-1



Recently Proposed SLI Concepts and OSP

One of 15 industry concepts. (Boeing)



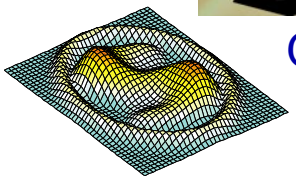
One of 15 industry concepts. (Boeing)


One of 15 industry concepts. (Lockheed)

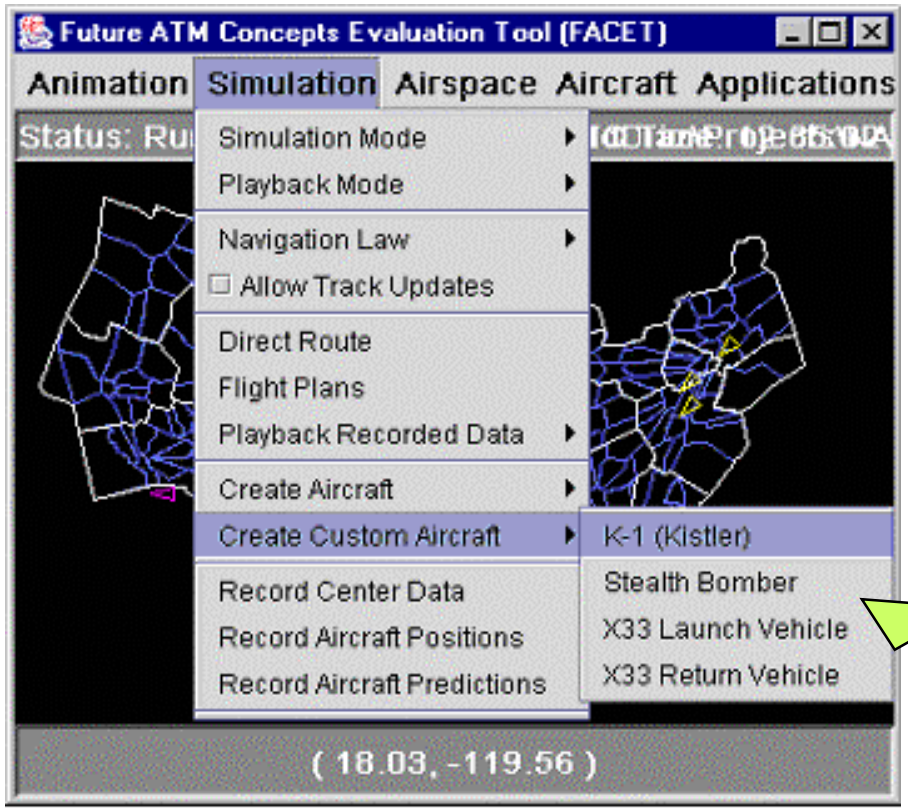

Orbital Space Plane

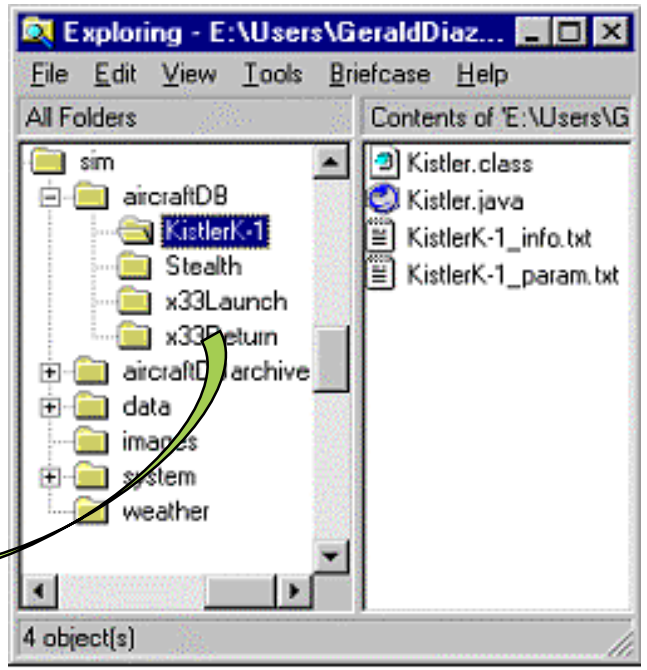

One of 15 industry concepts. (Northrop Grumman/Orbital Sciences)

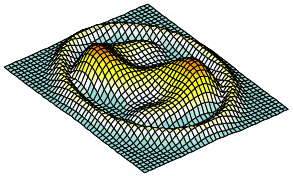

One of 15 industry concepts. (Northrop Grumman/Orbital Sciences)



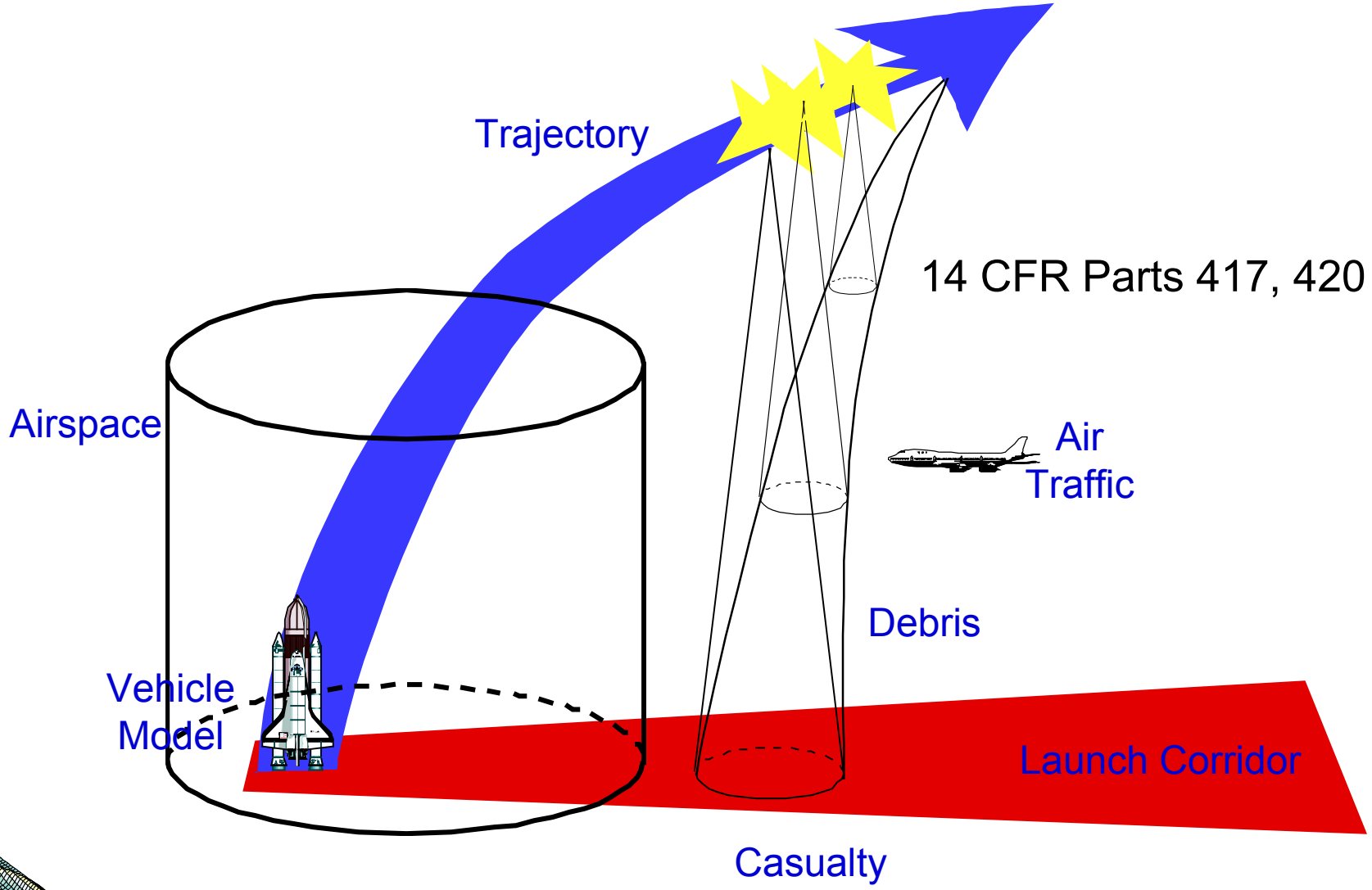
Example of FACET/CARAT Menu Automatically Updated by Model Database

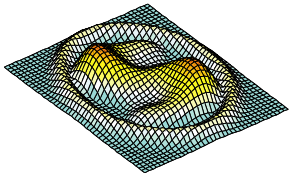




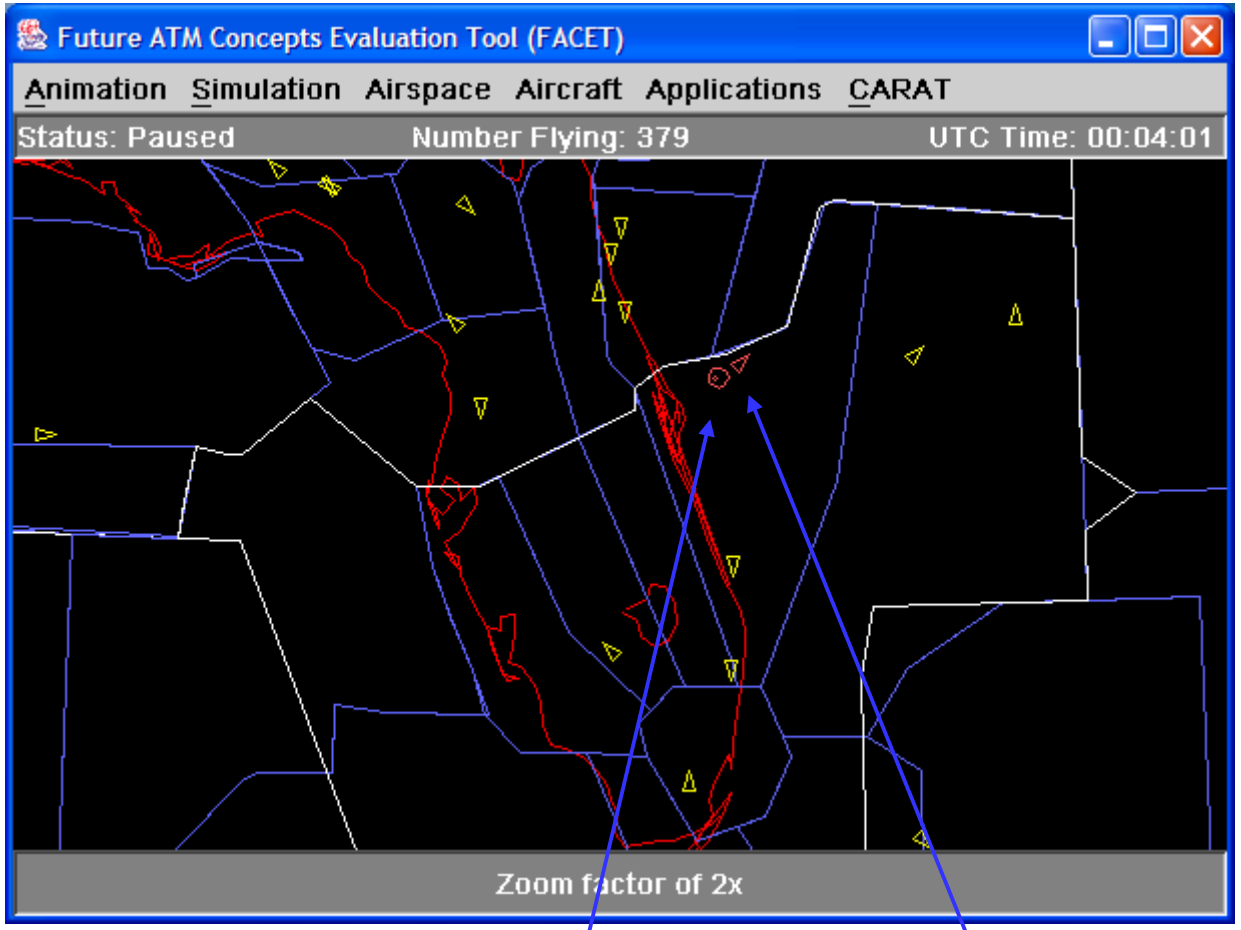


Analysis Functions



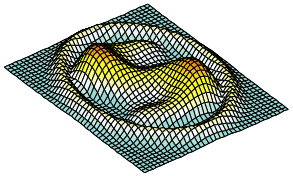


Example: 2STO Launch

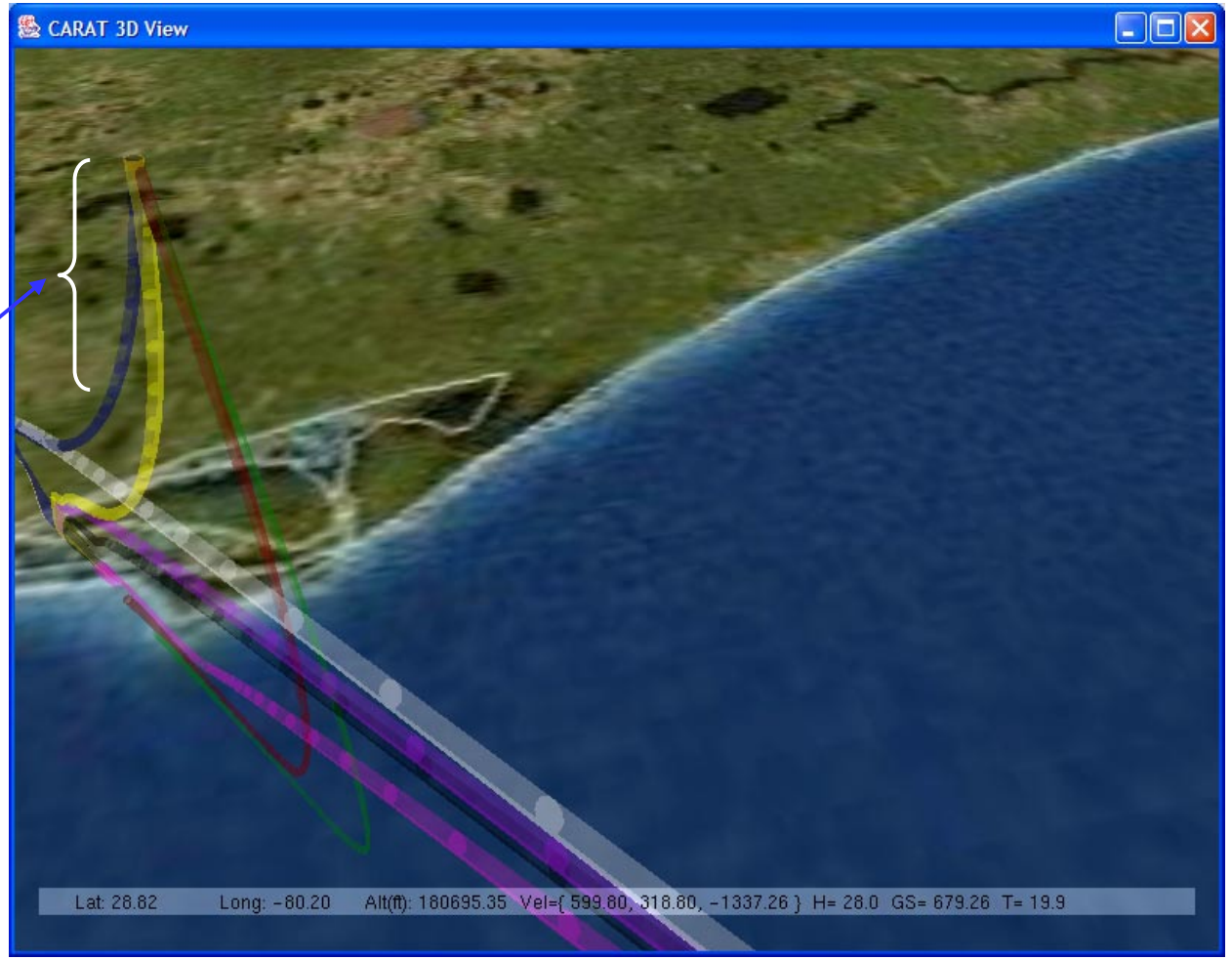


First Stage Pitches up after Separation for Return to Base

Second Stage Continues

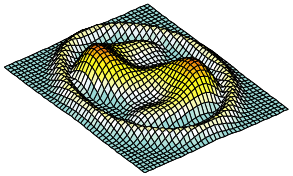


Example: 2STO — Launch

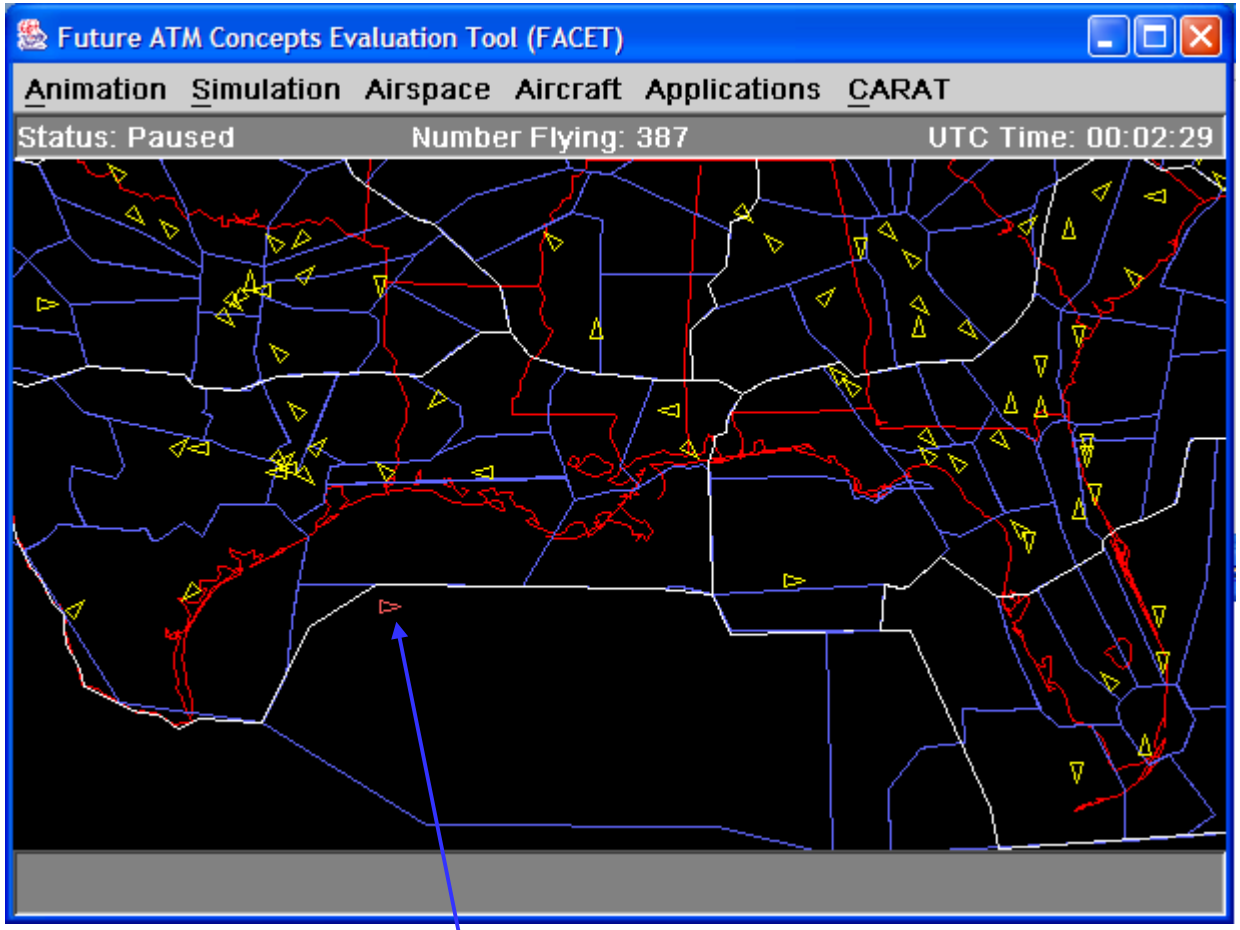


Potential Debris of Multiple Debris Classes from First Stage

Potential Debris from Second Stage

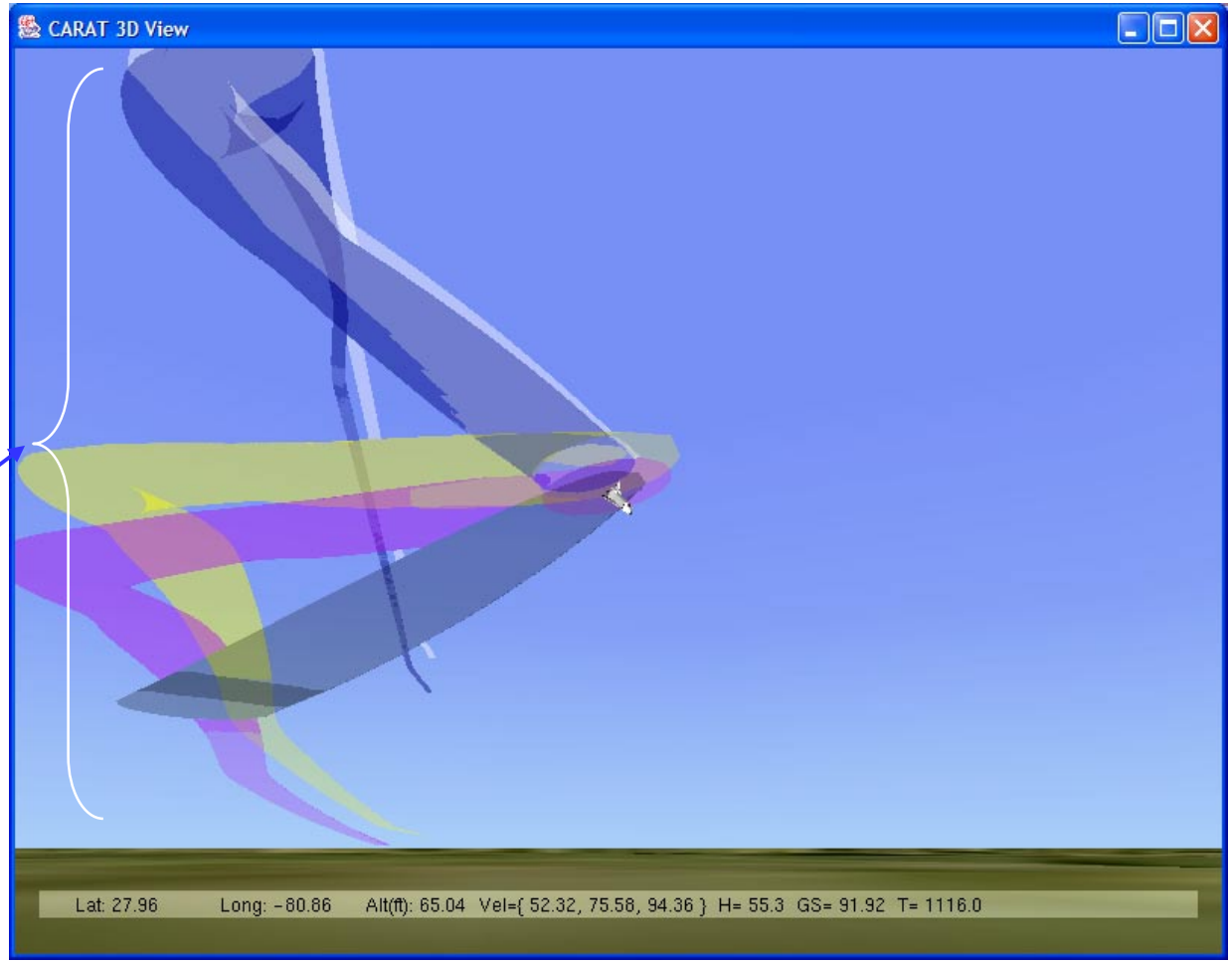


Example: Glide Return

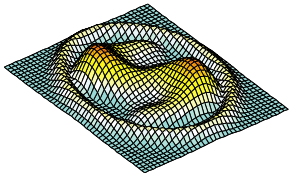


Return Vehicle

Example: Glide Return



Potential Debris of Multiple Debris Classes



Summary

- CARAT is an augmented version of FACET.
- CARAT provides flexible model database architecture to allow addition of vehicle models that can be automatically recognized by FACET.
- An initial set of launch and return vehicle models is provided.
- Flight safety analysis functions useful for launch vehicle licensing are being implemented based on FAA Licensing Rules, including impact of debris fallout on air traffic and population.
- Current SBIR development effort will be complete by May 23, 2003.